

Activity teaches mirror concepts

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Activity teaches mirror concepts

Considering that we all start off our day by looking in a plane mirror it might be a noteworthy experience for both children and adults to be able to understand and clarify in their minds the scientific explanation behind the principal function of a mirror. The image that is seen is always a virtual image. The image and the object are symmetrical with respect to the mirror. Explaining the symmetry of the 3D object can be more explicit with the image in the mirror. Would it be possible to free images seen in plane mirrors from their abstractness, turning this into an entertaining activity?

Image formation in plane mirrors

In a plane mirror, the light rays from the object do not intersect after reflection from a plane mirror, but it is their extensions that create an image by converging and intersecting behind the mirror. The description of this image is usually as follows: (1) the distances of the object and the image to the mirror are equal; (2) the image has the same size as the object, virtual and erected; (3) the image has front–back reversal. If the mirror surface is taken as a reference plane, then the object and its image can be seen as symmetrical formations of each other. For this reason, anything on the right side of the observer also appears on the right side of the mirror

(not on the left) (figure 4). Only the orientation of the image is changed with respect to the centre of the co-ordinate system. If the object is directed to z' , the image of the object is oriented towards z . For example, if a 3D graph was placed in front of a mirror (with axes x , y and z) only the z -axis co-ordinates would ‘appear’ to have had their values reversed (not rotated). As a result, a mirror produces only front–back reversal with respect to the plane mirror.

The best example that can be used to teach students this phenomenon is the activity described below, which visualizes front and back reversal in a plane mirror. The experiment begins by writing a word on transparent paper (figure 1). If we write down the same word on a transparent piece of paper (figure 2) and hold the paper to a mirror without turning the paper over (figure 3) the image that we see in the plane mirror is the same as the image in figure 1. In short, it is back-to-front reversal that takes place in a plane mirror. Descriptions are shown in a holistic way in figure 4.

In the context of the activity described above, the apparent left–right reversal in a plane mirror is difficult to explain and leads to misconceptions. This is because the apparent left–right reversal is due to our perception and is not real. A person looking at the image of an object in a plane mirror as an exter-

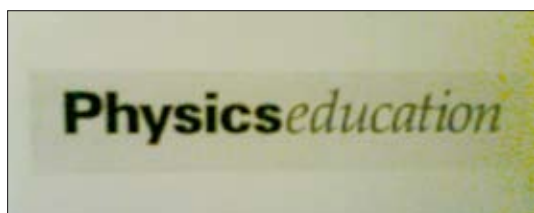


Figure 1. *Front view.*

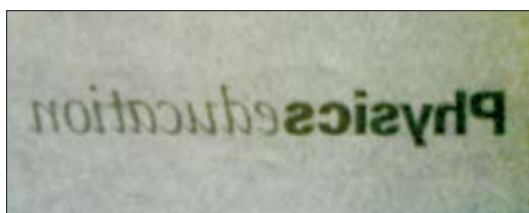


Figure 2. *Back view.*

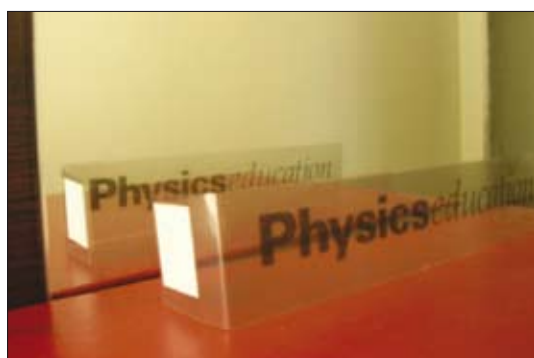


Figure 3. *View in the mirror.*



Figure 4. *Holistic view.*

nal observer will see that the image of the object is symmetrical with respect to the mirror plane. In this case, the image of the object with respect to the mirror plane can be explained by front-back reversal (this is when, as in the activity above, orientation with respect to one axis has changed). When we look at our own image in the mirror, however, it is not easy to make this observation. Left-right reversal is perceived because we have an ability in our minds to place ourselves where the virtual image is located. This is particularly true if we see a reflection of ourselves. This leads to a perception that if the real person raises their right arm then the virtual person is raising their left arm. For a person looking in from the outside, however, there are two images with different orientations, not left-right reversals but symmetrical images with respect to the plane of the mirror. Thus, the explanation of left-right reversal may be misleading because such an explanation only clarifies the perceived image and not the characteristics of the optic image.

Although learning basic optical concepts may not be difficult, misconceptions in this area do lead to problems in learning other concepts. In particular, not understanding virtual images leads to a failure to understand virtual images as seen in concave and convex mirrors. At the same time, phenomena

may seem more complex to students who are poor in connecting the methods of different disciplines. From this perspective, the activity discussed here, which has been designed as an introduction to the concept of image formation in plane mirrors, is simple and educational. The activity ensures that students are not drawn into misconceptions, making the teaching process more effective while awakening students' curiosity and encouraging them to think scientifically and, in particular, to become probing, inquiring individuals.

The activity is quite easy to conduct both at home and at school and has been found to be pleasant and educational for students and their teachers. The experiment may also be used as a game through the use of different pictures and texts.

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